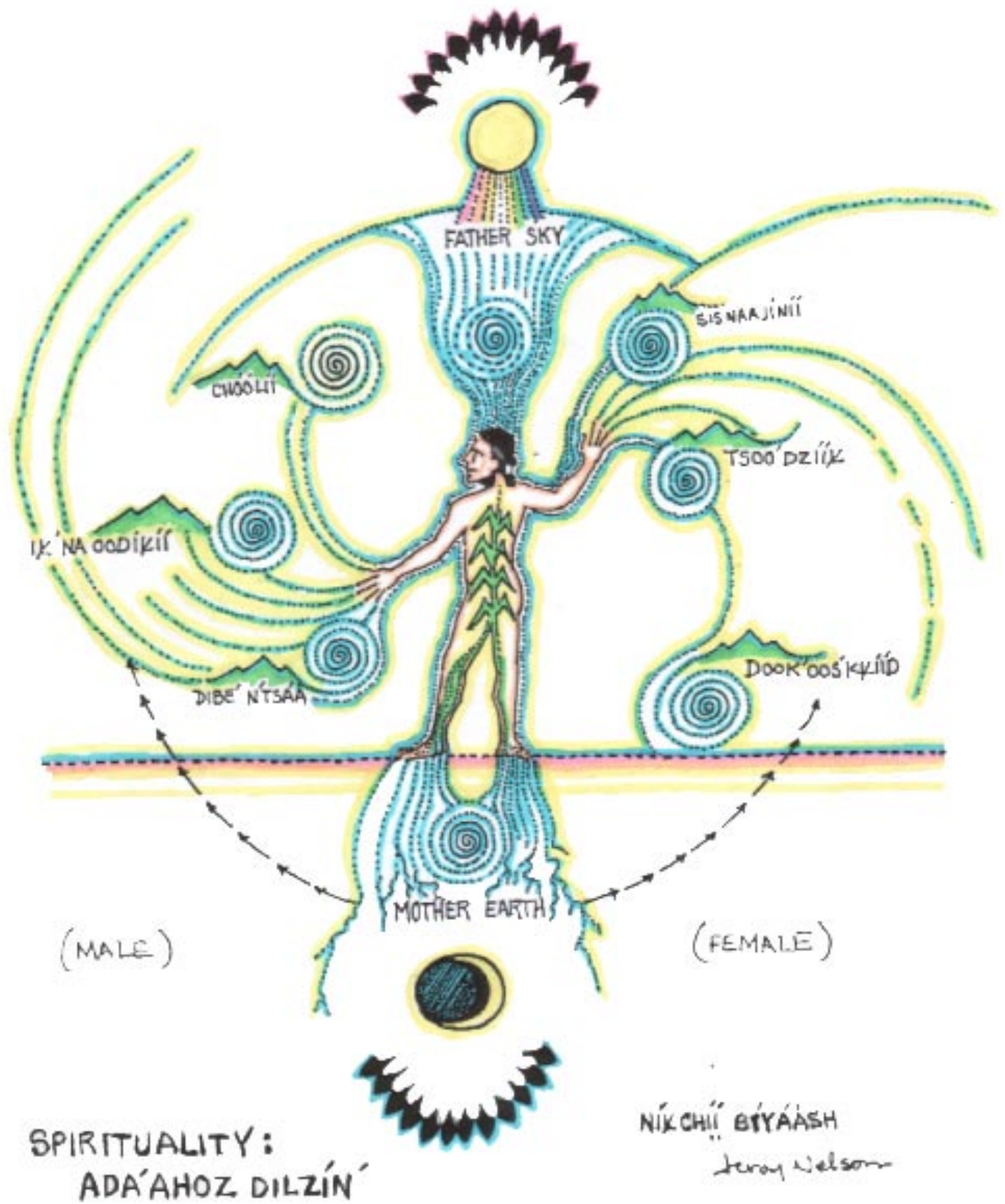


Exploring Stories Through Art



Overview

Objective – Through the process of making art, explore scientific concepts of stellar evolution, the Sun as a star, and the presence of organic material throughout space, and Navajo stories and concepts of the creation of star patterns and the relationship between humans and stars.

Age Range – This activity is designed for younger, elementary school aged children.

Materials Needed – 3 coloring sheets (provided as black line masters); crayons, markers, and/or colored pencils; a copy machine to reproduce the masters; NASA imagery (provided), background information for the facilitator (provided).

Set Up – Use one or two tables surrounded by chairs. Make the appropriate number of copies of each coloring sheet. Spread the coloring sheets and crayons around the table to provide easy access to them. Display the NASA imagery prominently on the table, a wall, or other visible space.

Estimated Time – 30 – 45 minutes; approximately one class period if used in a classroom.

Facilitator or Teacher Pre-Work – Before conducting the activity, read the science background information and Navajo stories pertaining to the coloring sheets. Have that material on hand while conducting the activity if desired.

How To

Guidelines for Facilitating the Activity

Assemble a group, ask them to choose a coloring sheet, and hand out crayons. Let them begin working. Start asking questions about what they're coloring. Use the background information and your creativity to ask appropriate questions and story-tell to make sense of what they're coloring (see below). If possible, read aloud the Navajo story *So Diyin Dine'e*, and The Diné Astronomy (provided). Refer to the NASA imagery for artistic inspiration. Encourage the use of bright colors for the stars in Cassiopeia (which represent gemstones in the Navajo story), and in the CassA Supernova Remnant. Encourage the use of more than one coloring sheet. If you're working in a Community Event, encourage parents and other family members to interact. The facilitator for this activity should be fluent in communicating with younger children. The children should take home their creations.



Community Night Event – Field Test in Cameron, AZ

In Coloring Sheet #1, “The Building Blocks of Life Are Not Just Here on Earth,” show the provided image of the galaxy M81. Explain that this galaxy is very far away from Earth, and can only be seen with a telescope. Point out that the pink color represents the presence of the building blocks of life. Explain that the image on the coloring sheet which looks like a piece of chicken wire fence is what makes up that pink color, and is found in many living things on Earth, like humans. Ask the students if they think life is possible elsewhere in the universe.

In Coloring Sheet #2, “*Nahookos ba’aadii* * Cassiopeia Shows a Supernova,” refer to the provided image of the CassA Supernova Remnant. Explain that this is an image of a star exploding at the end of its life, and that new stars can form from all the material it blasts out into space. Point out that with a telescope, CassA can be seen right next to the Navajo star pattern *Nahookos ba’aadii*, or Female Revolver, also known as the constellation Cassiopeia.

In Coloring Sheet #3, “Our Sun – Our Star – Our Life,” refer to provided image of the Sun, and the excerpt from The Diné Astronomy story. Explain that, according to that story, humans were made in the likeness of stars with five “points.” And, according to scientists, the “stuff” we are made of actually does come from stars that lived long ago.

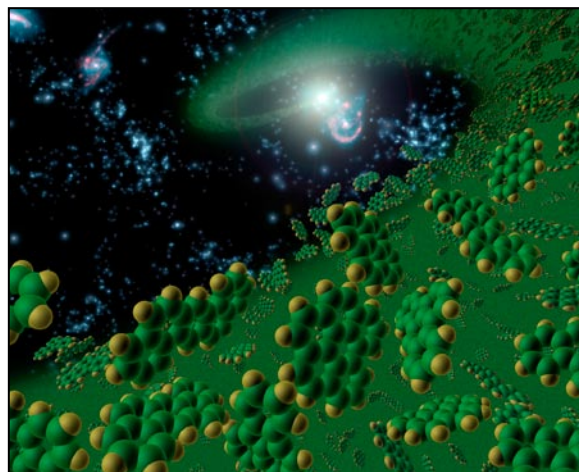
Background

Coloring Sheet #1: “The Building Blocks of Life Are Not Just Here on Earth”

This coloring sheet combines actual images (the galaxy), and graphic elements (the molecule and the Hogan). Nothing is shown to scale. The scientific concept themes for this coloring sheet are: Telescopes can see very far into space and detect very specific materials that exist in space. The same “stuff” that we are made of is found elsewhere in the universe in abundance. Are we alone? Could there be life elsewhere? Would it be like us?

SCIENTIFIC BACKGROUND

Spitzer, M81, and PAH’s: The image of the galaxy (called M81; 12 million light years away from Earth and visible within the constellation Ursa Major through binoculars or a small telescope) was taken by the NASA Spitzer Space Telescope in 2003. Spitzer does not “see” like human eyes which rely on visible light. Rather, Spitzer “feels the heat” of objects, and creates an image of them. The original image, provided here as part of this activity, shows a pink color (false color) in the spiral arms of the galaxy. This color represents very interesting material – extremely tiny bits of rocky material such as silicates (similar to beach sand), and organic (meaning carbon-containing) molecules. The organic molecules that Spitzer found are most interesting because they are similar to molecules central to life here on Earth, such as chlorophyll, which is made by plants and enables their growth. The molecules Spitzer found, represented by the chicken-wire shaped graphic in the coloring sheet, are called Polycyclic Aromatic Hydrocarbons, or PAH’s for short. PAH’s are flat molecules, shaped like chicken-wire, and can have many different shapes. The one shown contains nitrogen, which makes it even more Earth-life-like. Many of the molecules of life that are part of our bodies are related to PAH’s found in space. Even chocolate and caffeine are simple PAH’s!



PAH's From A Distant Galaxy (artist's rendition) NASA/JPL-Caltech/T. Pyle (SSC)

The Spitzer Space Telescope has directly observed the tell-tale signature of PAH's throughout space, in fact, these molecules seem to be just about everywhere. They are common in our own Milky Way galaxy and in distant galaxies such as M81. PAH's are chemically very stable and don't break apart in the high radiation environment in space. PAH's may become part of newly forming planets around other stars where they could be incorporated into other living things. The discovery of PAH's in other galaxies in such abundance makes scientists wonder about the possibility of life elsewhere.

Coloring Sheet #2: “*Nahookos ba'aadii* - Cassiopeia Shows a Supernova”

This coloring sheet combines graphic elements (the Hogan, the Stars of *Nahookos ba'aadii*, and the CassA Supernova Remnant). Nothing is shown to scale. The scientific concept themes for this coloring sheet are: Telescopes can see further and deeper into space than our eyes can see, beyond the stars of the night sky. The elements necessary for life and found in all life forms on Earth were made long ago in stars, and were recycled into space to be incorporated by the next generation of stars, planets, and possibly life.

SCIENTIFIC BACKGROUND

Chandra and CassA: In 1999, the NASA Chandra X-Ray Observatory, a telescope orbiting Earth and “pointing” away from the Earth, was able to take a picture of a supernova remnant in the constellation Cassiopeia (which is also the Navajo star pattern *Nahookos ba'aadii*). Just like Spitzer, Chandra does not “see” as human eyes do. Chandra measures X-rays, which are similar to rays of visible light, but of a much higher frequency. The provided image of CassA shows the X-rays the star let out at the end of its life.

Stellar Evolution: Throughout the universe, stars form, mature (often with planetary systems), and then die. In so doing, the star recycles the materials created within it back into space. When very large stars come to the end of their life, they do not go quietly! Such a dying star blasts off its outer layer in an energetic explosion, casting material out into the surrounding space. The star that produced the CassA Supernova Remnant came to such a fate 300 years ago.

This part of the life cycle of some stars, the supernova, is linked to the possibility of life elsewhere in the universe and the recycling of materials throughout the cosmos. Some of the elements that are cast out into space during a supernova event – oxygen, carbon, and nitrogen to name a few – are elements that are necessary for life as we know it. The only place these elements are made is within the superheated core of a star. If this process were not in place, our Solar System would not be the way it is! Current scientific theory states that our Solar System incorporated the material cast off by a nearby supernova event, and our planet and the life on it was made from that material. We, indeed, are made of star stuff. What will become of the material cast out from the CassA Supernova? Could new stars and solar systems form in its wake?

An Excerpt From:
Só Diyin Dine'é

Told by Irvin K. James, 2001
Transcribed by Sylvia Jackson

Produced by the Office of Diné Culture, Language, and Community Services
Division of Diné Education

The Holy Ones discussed the growing process, as they observed and understood it. If all living things return to the Earth and are replaced with new life, then there is a growing process in place. The Holy Ones met, discussed, planned, and laid out the constellations by which the People will understand the passage of time, growing, and aging.

One day was set aside for everyone to participate. Haashch'eealti'i placed a flawless buckskin on the ground. Other Holy Ones brought precious gems of all colors, sizes, and shapes to produce specific patterns and designs to depict their character and ability. First man constructed a pattern he called Nahookos Bik'a'ii, the Big Dipper. He chose seven colorful stones in the pattern. First Woman constructed a pattern she called Nahookos Bi'aadii, Cassiopeia, and had five stones in the pattern. They placed the patterns in the northern sky around the North Star, with their own fire hearth between them. The pair will revolve around their fire hearth, Nahookos Bikq, the North Star. Everyone was satisfied with the arrangements.

The constellation patterns placed in the sky were discussed and designed for specific purposes such as the Nahookos Bik'a'ii and the Nahookos Bi'aadii and the fire hearth, Nahookos Bikq. The pattern exhibits changes of the season. In the early spring, Nahookos Bi'aadii will be visible in the northeastern sky. Nahookos Bik'a'ii will be visible in the same location in the early fall evening. Nahookos Bikq, the North Star, remains in one location all the time. All constellations revolve around the North Star.

The traditional understanding is that the constellation patterns depict proper roles and responsibilities of families. Nahookos Bik'a'ii reigns over the fall and winter seasonal activities for the People. Ye'i'ii Bichei and ilnashjinji hataal are winter healing ceremonies. Nidaa and Hozhonjii Hataal are the spring and summer healing ceremonies under the reign of Nahookos Bi'aadii. Being aware of the purposes of the constellations helps in understanding the traditional practices of Diné Way of Life.

Coloring Sheet #3 “Our Sun – Our Star – Our Life”

This coloring sheet combines actual images (the Sun), and graphic elements (the Hogan and the stars). Nothing is shown to scale. There are two themes for this coloring sheet: Our Sun as a star, and the five-points of a human (torso, two arms, two legs) mimicking the five-points of a star.

SCIENTIFIC BACKGROUND

The Sun: Our Sun is a star in its main sequence phase. It is the largest object in our Solar System and contains approximately 98% of the total solar system mass. One hundred and nine Earths would be required to fit across the Sun’s disk, and its interior could hold over 1.3 million Earths.

The Sun formed just as other stars do. The concept of star formation begins with diffuse material in clouds of **gases** such as carbon monoxide and hydrogen gas, **dust** meaning small rocky particles such as silicates like beach sand, minerals such as olivine, organic particles like charcoal dust, and **ices** such as water ice. The particulate matter and gases have a random motion. A pressure blast, or “wind” such as the radiation produced from a nearby dying star (supernova) can cause the diffuse material to begin to coalesce and increase in density at certain points which will eventually become discreet stars. A small, growing star is surrounded by a circumstellar disk of spinning dust and gas, like a music CD or Frisbee, with the young star in the center. Through a process called accretion, the material will condense further. The more mass it gains and the larger it gets, the more material will be attracted to it. In this way, it gains even more mass and gets even larger. Please refer to the film for a visual explanation of this. Eventually, the density of material reaches such a high level that the nuclei of the atoms in the gas and dust are under such pressure that they fuse, and begin to form new elements. Huge amounts of energy are given off in the process which we observe as heat and light. We on Earth are intricately linked to the Sun whose light and heat are responsible for maintaining life.

The Sun is an average star, in that there are other stars which are much hotter or much cooler, and intrinsically much brighter or fainter. However, since it is by far the closest star to the Earth, it looks bigger and brighter in our sky than any other star. The Sun is mostly made up of hydrogen (about 75% of the mass). Helium can also be found in the Sun (about 25% of the mass). The remainder is made up of heavier elements, mainly carbon, nitrogen, oxygen, neon, magnesium, silicon and iron. The Sun is neither a solid nor a gas but is actually plasma. This plasma is tenuous and gaseous near the surface, but gets denser down towards the Sun’s core.

The Sun is not just a big bright ball. It has a complicated and changing magnetic field, which forms things like sunspots and active regions. The magnetic field sometimes changes explosively, spitting out clouds of plasma and energetic particles into space and sometimes even towards Earth.

Scientists think that stars like the Sun shine for nine to ten billion years. The Sun is about 4.5 billion years old, judging by the age of moon rocks and meteorites. Based on this information, current astrophysical theory predicts that, in five billion years, the Sun will puff up into a red giant and “swallow” much of the Solar System.

NAVAJO STORY

5-Pointed Stars: The 5-pointed stars in the image represent the Navajo story which describes how humans were made in the likeness of stars. Both humans and stars have “5-points.”

An Excerpt From: *The Diné Astronomy*

From the Chinlé Unified School District
Dedicated to Dr. Dean C. Jackson

After the creation of the Earth, sky, and the atmosphere, the Holy people realized that the whole universe was entirely dark. There was no form of light to illuminate the universe. So the Holy people reconvened to discuss how to remedy this situation. Since there was no source of light, there was no order and direction, and no measurement of time. Once they had a means of measuring time and having light to see with, they would set about organizing the rest of the world.

They gathered all different types of materials that they thought would be good as a light source. While they were debating on an adequate instrument that could give out light, a certain young man came forward and pulled out a turquoise spherical object from his cloak. “This will be the instrument that will be the container of light. The ‘First Fire’ (Átsééh kq) will be the source to energize it with light and heat. We will put this fire in the turquoise sphere,” he announced. “But you must place all your prized possessions of gems and other valuable items on the buckskin.”

The people did not know who this young man was or why he wanted their precious possessions, but they did as he instructed. They brought forth turquoise (doot’izhii), whiteshell (yoolgai), abalones (diichilii), black jet stones (bááshzhinii), obsidian (noolyínii), coral (tselchí’í), and many other precious gems. They also brought forth other beautiful and prized material possessions. They piled these on the buckskin as they were instructed. They were all curious and awed by his assumption of authority in the matter. This young man seemed to know what he was doing.

At length, the quiet young man came forth again. He said, “These precious gems and other belongings that you have brought forth will be placed within the turquoise sphere and it will be known as ‘One That Travels During the Daytime’ or Sun, Jihonaa’éí. It will send its rays to the Earth and these rays will embody all these valuables that you have given, the Sun will give wealth and goodness to the Earth and all its inhabitants.” The people placed features on the face of the sphere. They also placed arms, legs and torso on it. The young man was instructed to place emotions in the sphere so that it would feel compassion, like anger, sadness, and happiness.

The Sun must be like Earth people so he could understand their needs and be forgiving when they neglected to do their duties. The young man took a portion of First Fire (Alsé K'q') and ignited the sphere with it. Immediately the sphere burst into flames. The heat and light from it were so hot and bright that many shrank from it and shielded themselves. The ground beneath and around the Sun burned from the great heat it radiated. It was clear to the People that the Sun could not remain on or near Earth as they had originally planned. Another alternative had to be found before the whole Earth was burned to a crisp.

Suggestions were given quickly due to the urgency. Some said the Sun should be hung from the sky, others thought that placing it on a high mountain would solve the problem. Still others suggested that the wind could blow it in the sky and retain it there. The most practical ideas were tried. There was great confusion and panic as they tried to solve the problem as quickly as possible. As others ran about in a state of frenzy, the young man came forward again. Very calmly he said, "Perhaps someone should carry the Sun above the Earth. In this way the whole sky could be filled with light and warmth rather than having small portions being filled at a time." The young man instructed that someone with great power should have to enter the Sun and ascend above the Earth and remain in the sky. Once more there was a scramble as volunteers came forward. Each of the volunteers tried using all his powers and strength to carry the Sun, but none was successful. Even Coyote entered the sphere as the others had done. Summoning every ounce of strength in his body, straining every muscle, he heaved and heaved pulling tendons and ligaments, but even he could not lift the Sun. After several heroic tries, even Coyote had to admit that he could not lift the burning Sun. Exhausted, he went to the sidelines and waited with the others.

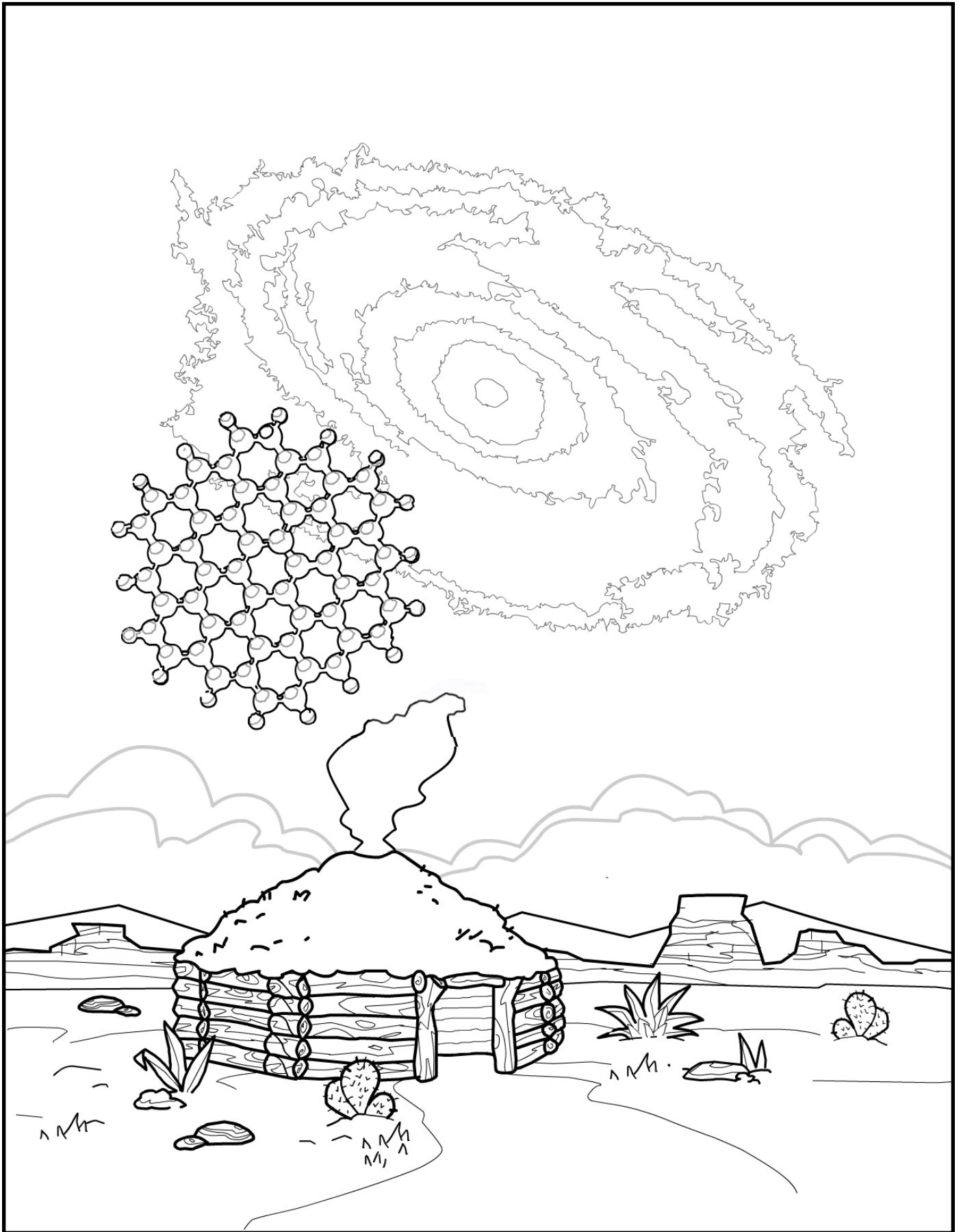
The young man came forth again and announced that he would carry the Sun. But he decreed that for every day he carried the Sun, a life on Earth would be taken. "This will be my payment," he said. The people gathered and had to agree for there was no other way. The young man entered the Sun and ascended into the sky. He did not have to struggle as the others had because he was the only one that possessed the power and knowledge to exert influence and great force to make it function properly.

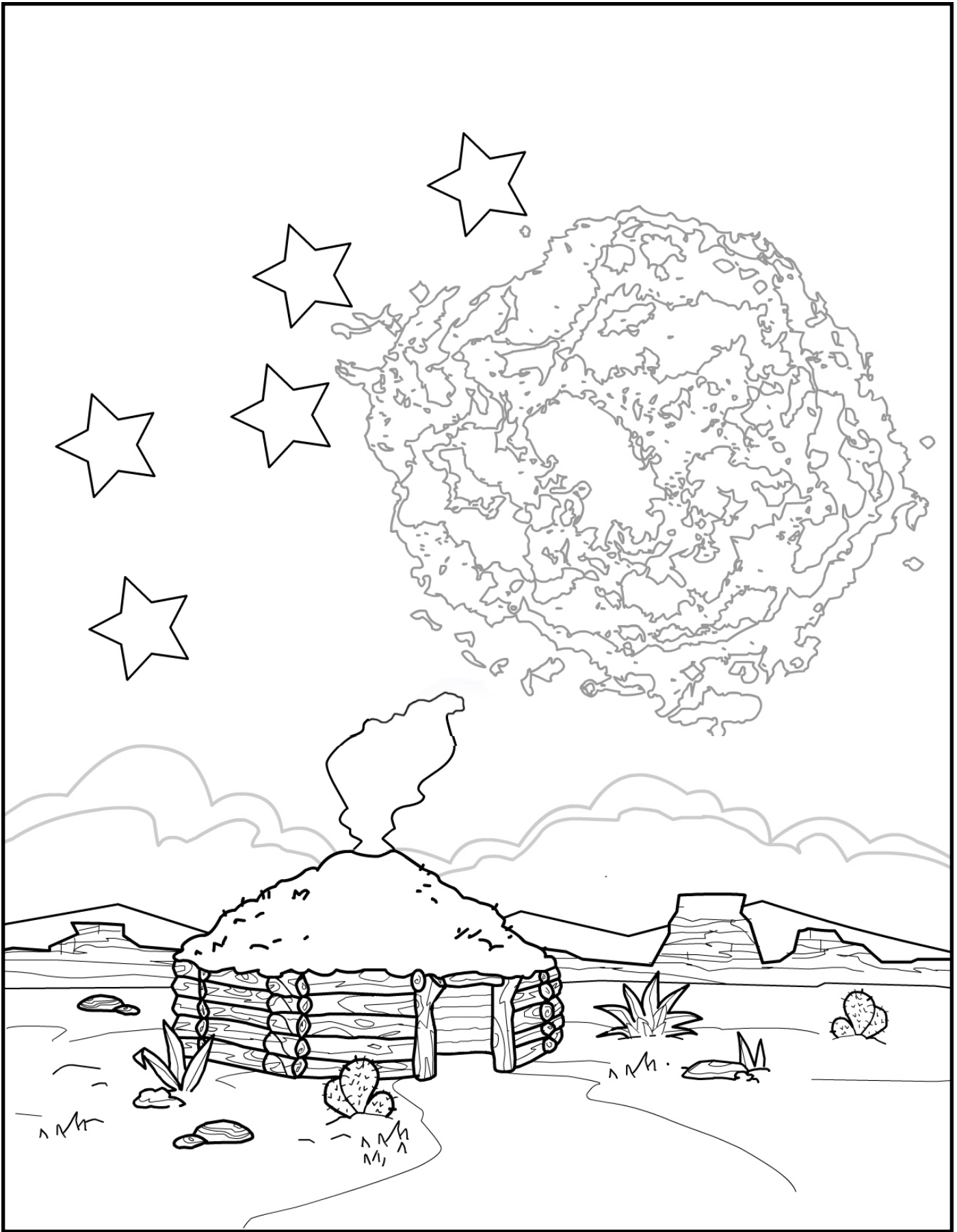
It was also declared by the people that the Sun would rise from the east and set in the west. This set the four cardinal directions for the people. He must travel in a circle in a counter clock direction (Shábik'ehgo). This would induce and require complete cycles for all life on Earth. Another order to everything was made.

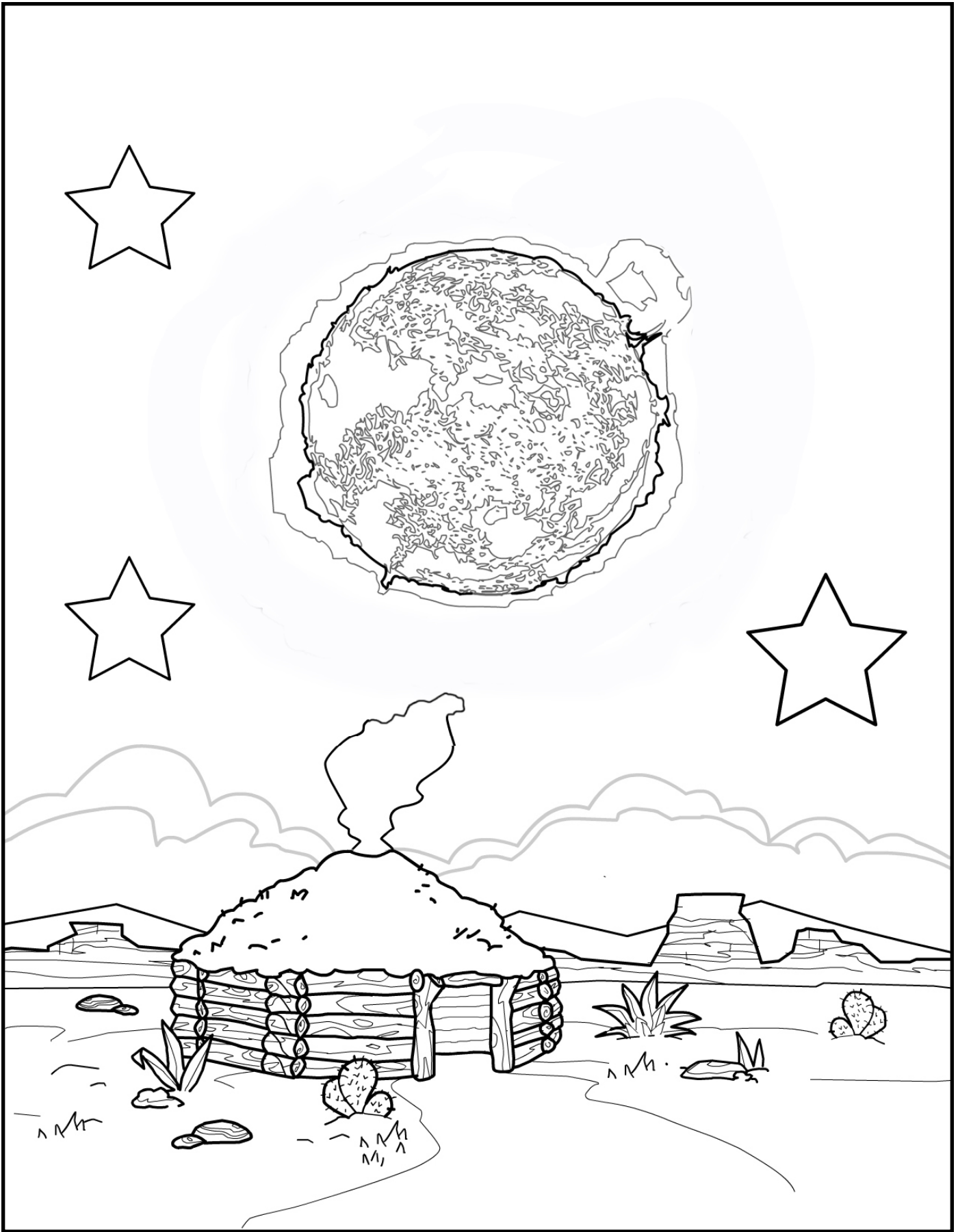
Graphics

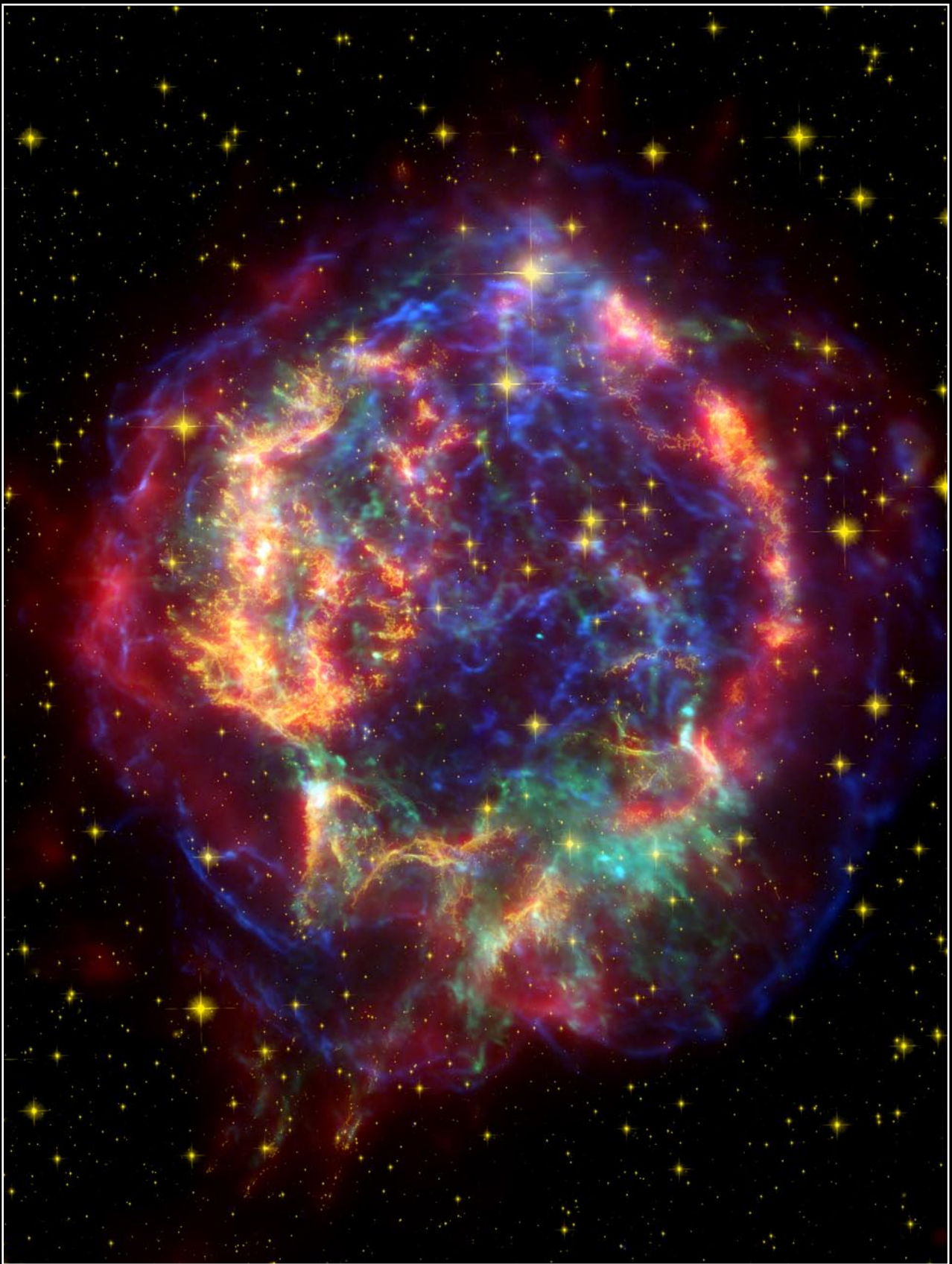
The following several pages contain the provided graphics for this activity: black line masters of the three coloring sheets for photocopying, plus reference images of CassA, M81, and the Sun that can be cut out of the booklet and displayed while conducting the activity.











Cassiopeia A Supernova Remnant

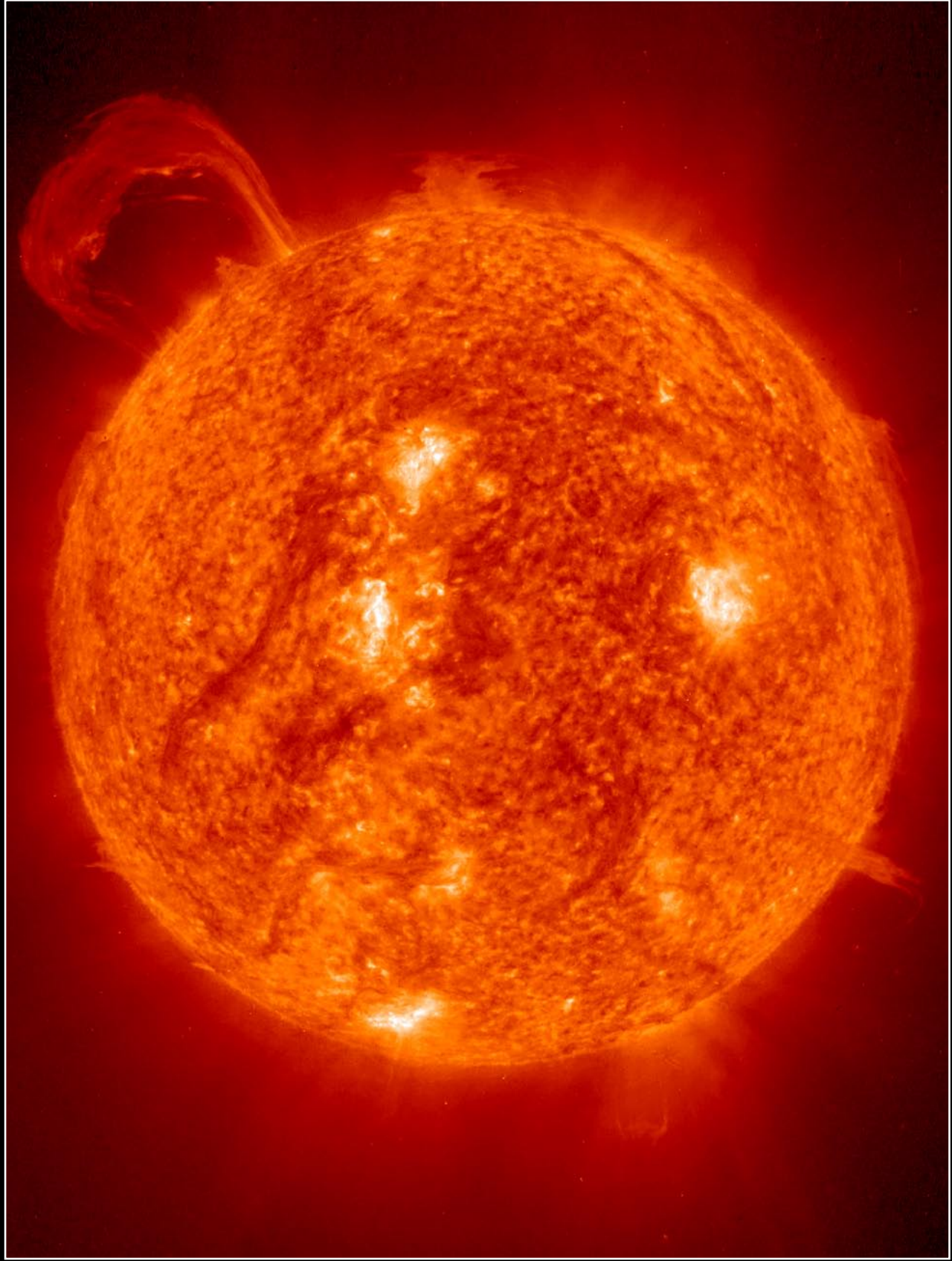
Spitzer Space Telescope • MIPS / HubbleSpace Telescope • ACS / Chandra X-Ray Observatory
NASA/JPL-Caltech / D. Krause (Steward Observatory)



Spiral Galaxy M81

Spitzer Space Telescope • IRAC

NASA / JPL-Caltech / S. Willner (Harvard-Smithsonian CfA)



The Sun

NASA Solar and Heliospheric Observatory

